

INDO-PACIFIC PISANIINAE (MOLLUSCA: GASTROPODA) AND RELATED BUCCINID GENERA

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Abstract. Genus-groups of the subfamily Pisaniinae and their relationship to other buccinid genera are evaluated. Species of Buccinidae living in the Fiji Islands are described and illustrated.

During a study of Pacific Buccinidae, their shells and radulae, it became apparent that several genus-groups proposed for Indo-Pacific buccinid species appeared to be superfluous. Comparisons of radulae and morphological characters of Indo-Pacific species, demonstrate a close relationship between several genera of the subfamily Pisaniinae. Some of the currently accepted names of buccinid species were found to be primary or secondary homonyms and had to be replaced by new combinations from available synonyms.

Family BUCCINIDAE Rafinesque, 1815 (ex-Buccinidia)

Photidae Kobelt, 1881, Syst. Conch. Cab., *Buccinum*, ed. 2, 3(1) : 1; Cooke, 1917, Proc. Malac. Soc. Lond. 12 : 237; Ripplingale & McMichael, 1961, Old. Gt. Barrier reef shells, p. 109; Iredale & McMichael, 1962, Mem. Aust. Mus. 11 : 69 (ex-Photina Troschel, 1867).

Pisaniidae Locard, 1897, Exp. sci. Trav. "Talisman", 1 : 320 (ex-Pisaniinae Tryon, 1881).

Buccinulidae Finlay, 1928, Trans. Proc. N.Z. Inst. 59 : 250.

Cominellidae Powell, 1929, Trans. Proc. N.Z. Inst. 60 : 59 (ex-Cominellinae Cossmann, 1901).

Austrosiphonidae Cotton & Godfrey, 1938, Malac. Soc. Sth. Aust. Publ. No. 1 : 24.

Pusiostomatidae Iredale, 1940, Aust. Zool. 9(4) : 434 (for *Engina* group of species).

Several closely related genera have been segregated in separate families without documented proof that such an elevation in rank is biologically imperative. The classification of genera has been largely based on either common diagnostic shell-features or differences in dentition, and in some instances geographical distribution. As far as the dentition is concerned, some workers have placed more reliance on the shape and number of cusps of the rachidian teeth, while other investigators considered the laterals to be of diagnostic importance.

A classification of buccinid genera based entirely on radula features would in many instances produce incongruous results through combinations of genera which do not appear to be closely related at all. Tropical Indo-Pacific Pisaniinae of the *Pisania-Acamptochetus* group share the same type of rachidian with the temperate water genera *Buccinulum*, *Euthria* and juvenile specimens of *Burnupena*. With the exception of *Burnupena* and partly the subfamily Photinae, lateral

teeth in Buccinidae are variously modified types of a prototypic tricuspid lateral; these modifications are not confined to a particular genus and appear sporadically in various genera. The conclusion is, that the buccinid radula is often more reliable in distinguishing between species than it is in separating genera.

Subfamily PISANIINAE Tryon, 1881

Pisaniinae Tryon, 1881, Man. Conch. 3:98.

Shell small to medium in size, 10-50 mm, fusiformly-ovate to fusiformly elongate; smooth or sculptured with spiral threads, cords, axial striae or granules. Aperture narrow, elliptical or fusiform, labial lip often exteriorly thickened by a varix, interiorly smooth or finely denticulate; columella calloused, parietal wall with or without a distinct denticle, sometimes denticulate along entire length of the columella, anterior end of columella frequently with an angular projection. Labial denticles continuing for a short distance into aperture, siphonal canal moderately short but distinct.

The radula of Pisaniinae consists of square to shortly rectangular rachidians with 3-5 cusps; in some species the cusps are obsolete and indicated by axially incised, blunt denticles. The operculum is corneous, with a basal nucleus.

Genus *Pisania* Bivona, 1832

Pisania Bivona, 1832, Effem. Sci. Lett. Sicil. Palermo 2:8. Type species by SD (Pace, 1902) *P.striatula* Bivona, 1832 = *Murex striata* Gmelin, 1791. Recent, Mediterranean.

1850. *Polliana* E. M. Gray, Figs. Moll. Anim. 5:67 (publ. in synonymy of *Pisania* Bivona)
 1904. *Taeniola* Dall, Smiths. Misc. coll. 47: 137. Type species by OD *Triton decollatus* Sowerby, 1833. Recent, Pacific. (non Pallas, 1760).
 1924. *Prodotia* Dall, Proc. Biol. Soc. Washington 37:89. Type species by OD *Pisania billeheusti* Souverbie (= Petit de la Saussaye) = *Buccinum gracile* Reeve, 1846. Recent, Indo-Pacific.
 1929. *Appisania* Thiele, Handb. syst. Weicht., p. 314. Type species by M *Metula (Appisania) montrouzieri* Crosse = *Pisania crenilabrum* A. Adams, 1855. Recent, Indo-Pacific.
 1966. *Sukunaia* Cernohorsky, Veliger 9(2): 229. Type species by OD *S.jenningsi* Cernohorsky, 1966. Recent, Pacific.

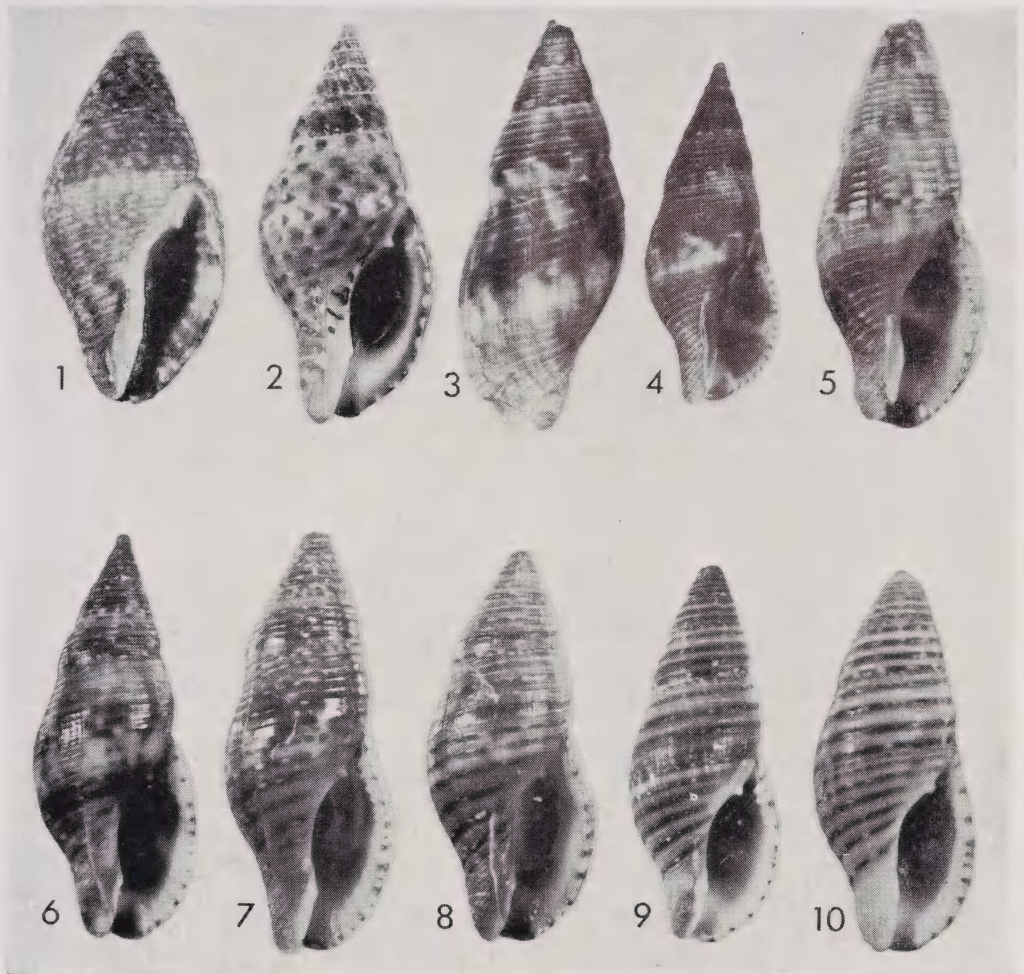
Pisania crenilabrum A.Adams, 1855

(Figs. 3-9, 18, 30)

1855. *Pisania crenilabrum* A. Adams, Proc. Zool. Soc. Lond. p. 138.
 1862. *Pisania montrouzieri* Crosse, J. Conchyl. 10:251, pl. 10, fig. 5 (New Caledonia).
 1903. *Pisania crenilabrum* Adams, E. A. Smith, Proc. Malac. Soc. Lond. 5:372.
 1929. *Metula (Appisania) montrouzieri* Crosse, Thiele, Handb. syst. Weicht. 1:314, fig. 347.
 1966. *Appisania montrouzieri* (Crosse), Cernohorsky, Veliger 9(2): 232, pl. 20, figs. 5-8.

TYPE LOCALITY: West Indies —error! (New Caledonia for *P.montrouzieri*).

Smith (1903) drew attention to the fact that Adams' locality indication for *P.crenilabrum* was an error. During an examination of the types of *P.crenilabrum* at the British Museum (Nat.Hist.), London, the present author found *P.crenilabrum* to be the same species as *P.montrouzieri*. The 3 syntypes of *P.crenilabrum* have the following dimensions: 1) length 24.8 mm, width 10.4 mm, height of aperture 13.4 mm (here selected as the lectotype); 2) length 21.2 mm, width 8.5 mm, height of aperture 11.2 mm; 3) length 20.9 mm, width 8.1 mm, height of aperture 10.8 mm. The smallest specimen is immature and the protoconchs are missing in the large adult specimens.



Figs. 1-10. Shells. 1. *Pisania striata* (Gmelin). Malta; length 21.8mm. 2. *P. pusio* (Linnaeus). Pelican Shoals, Florida; length 21.8mm. 3-9. *P. crenilabrum* A. Adams. West Indies (error! = Indo-Pacific). 3. Lectotype B.M.N.H.; length 24.8mm. 4. Syntype B.M.N.H.; length 20.9mm (immature). 5. Northwest Island, Queensland, Australia, intertidal; length 20.2mm. 6. Viti Levu Bay, Fiji I., intertidal; length 23.7mm. 7. Suva reef, Fiji I., intertidal; length 27.6mm. 8. Hazlewood I., Whitsunday Group, Queensland, Australia, intertidal; length 21.3mm. 9. Rat Tail Passage, Suva, Fiji I., intertidal; length 28.8mm. 10. *P. fasciculata* (Reeve). Davao, Mindanao, Philippine I.; USNM No. 231048; length 27.2mm.

The species is variable in colour, being either brown, reddish-brown, grey or purplish, and is occasionally ornamented with axial streaks and small white spots on the spiral striae; in some specimens the dark axial zones and white spots are absent. Some specimens closely resemble *Buccinum tritonoides* Reeve, 1846, described from the Island of Ticao, Philippines. The radula of "*Ecmanis tritonoides* Reeve" as figured by Habe (1958, pl.3, fig.10), is the radula of a *Cantharus* or *Polia*, while the specimen illustrated by Habe & Kosuge (1967, pl.31, fig.13) as "*Ecmanis tritonoides*" appears to be a different species. *Appisania sugimotoi* Habe, 1968, from Japan, is very similar to *P. crenilabrum* and differs only in colour.

Pisania crenilabrum A.Adams, is the type species of *Appisania* Thiele, 1929, originally proposed as a section of *Metula* H. & A. Adams.

Pisania fasciculata (Reeve, 1846) (Fig. 10)

1834. *Triton (Pusio) vexillum* Gray in Griffith & Pidgeon, Anim. King. Moll. Rad. Cuvier, 12, pl. 37, fig. 5.
 1846. *Buccinum fasciculatum* Reeve, Conch. Icon., pl. 10, sp. 76.
 1966. *Appisania fasciculata* (Reeve), Cernohorsky, Veliger 9(2): 232, pl. 20, fig. 9.

TYPE LOCALITY: Island of Mindanao, Philippines.

This species is rather similar in general appearance to *P.crenilabrum*, but the spiral striae are less numerous, wider spaced and thicker; the base colour is white or creamy-yellow, and the cords are reddish-brown and occasionally spotted with white.

Triton (Pusio) vexillum Gray in Griffith & Pidgeon, is an undetermined species which closely resembles beach-worn specimens of *Pisania fasciculata*.

Future population studies of the closely related *P.fasciculata* and *P.crenilabrum* may show that the two species are conspecific. The present author has observed intergrading specimens from the Tonga Islands, Fiji and N.E. Australia.

Pisania decollata (Sowerby, 1833) (Figs. 13-14, 19, 31)

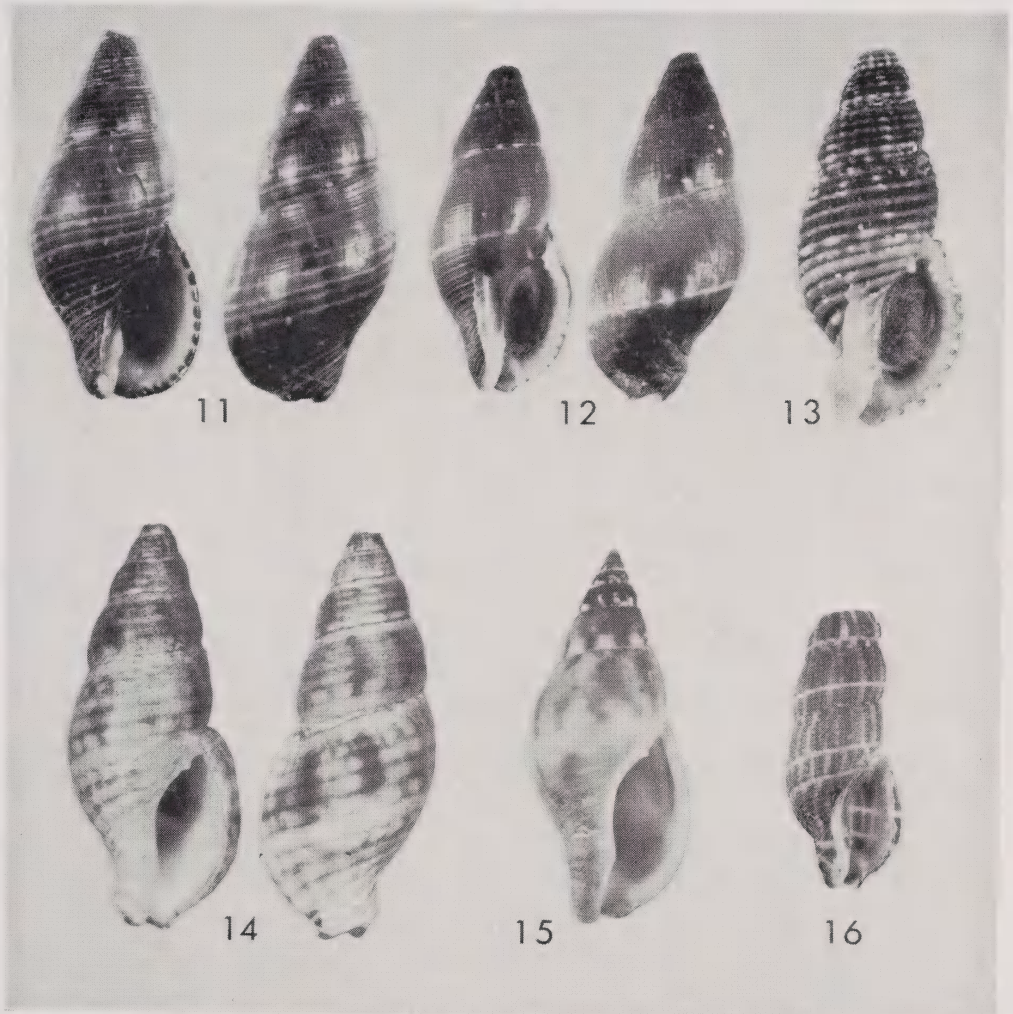
1833. *Triton decollatus* Sowerby, Proc. Zool. Soc. Lond., pt. 1: 72.
 1844. *Triton decollatus* Sowerby, Reeve, Conch. Icon., *Triton*, pl. 18, sp. 82.
 1863. *Pisania strigata* Pease, Proc. Zool. Soc. Lond. 1862: 241 (Pacific Islands).
 1868. *Pisania strigata* Pease, Amer. J. Conch. 4(3): 93, pl. 11, fig. 6 (Ponape I., Caroline Islds.).
 1965. *Pisania strigata* Pease, Kay, Bull. Brit. Mus. (Nat. Hist.), Zool. Suppl. 1:72, pl. 12, figs. 16, 17.

TYPE LOCALITY: Anaa Island, Tuamotu Archipelago.

The colouring of the species is reminiscent of *Cymatium hepaticum* (Röding): the prominent spiral cords are reddish-orange in colour and granose, and the interstices are blackish-brown, spirally lirate and axially decussate; small white spots or blotches are irregularly distributed over the whorls. The labial varix and columellar shield are prominent, the anterior of the columella has 2-3 irregular denticles and the labial lip is denticulate. The protoconch is immersed in the teleconch in adult specimens. The operculum is light brown, with a basal nucleus. The radula (Fig. 19) is similar to the radula of *Pisania crenilabrum*; the small central denticle of the lateral is at times obsolete or missing.

The lectotype of *Pisania strigata* Pease, is in the British Museum (Nat.Hist.), London, No.1964288. The dimensions are length 33.4 mm, width 13.7 mm, height of aperture 17.0 mm; the type is worn, faded and not fully mature. *P.decollata* appears to be confined to the Pacific region.

Pisania decollata (Sowerby) is the type species of *Taeniola* Dall, 1904, originally proposed as a genus-group in the taenioglossate Cymatiidae. *Taeniolo* Dall, is a homonym of *Taeniola* Pallas, 1760.



Figs. 11-16. Shells. 11. *Pisania jenningsi* (Cernohorsky). Naevuevu, Fiji I., intertidal; holotype USNM No. 673301; length 23.2mm. 12. *P. luctuosa* Tapparone-Canefri. Tavarua I., W. off Viti Levu, Fiji I., intertidal; length 18.7mm. 13, 14. *P. decollata* (Sowerby). 13. Rat Tail Passage, Suva, Fiji I., intertidal; length 23.0mm. 14. Lectotype of *P. strigata* Pease. Pacific Islands. B.M.N.H. No. 1964288; length 33.4mm (beach-worn and faded). 15. *P. (Ecmanis) ignea* (Gmelin). Rat Tail Passage, Suva, Fiji I., intertidal; length 22.0mm. 16. *P. (Caducifer) truncata* (Hinds). Rat Tail Passage, Suva, Fiji I., intertidal; length 15.0mm.

***Pisania jenningsi* (Cernohorsky, 1966)**

(Figs. 11, 22)

1966. *Sukunaia jenningsi* Cernohorsky, *Veliger* 9(2): 299, pl. 20, figs. 1-4.

TYPE LOCALITY: Naevuevu village, Southwest Viti Levu, Fiji Islands.

The species is more inflated and bulbous than other *Pisania* species and almost smooth apart from a few irregular fine striae; the columellar shield is ill-developed and only visible anteriorly, the aperture is wide and oval and the labial denticles are blunt and obsolete.

The radula (Fig. 22) has tricuspid laterals similar to those of *Pisania*, and the rachidians have obsolete denticles which rarely protrude over the margin of the plate. The operculum is light brown with 2 purplish-black axial zones and a basal nucleus.

The unusual and cusplless rachidians of the radula previously prompted the present author (1966) to propose the genus *Sukunaia* for this species, since this type of rachidian has not previously been recorded in the Buccinidae. The discovery of the same type of cusplless rachidian in the species *Pisania marmorata* (Reeve) [= *P. gracilis* Reeve] a species similar in appearance to *Pisania* but with a granose sculpture, demonstrates the variability of rachidians within species of the same genus. The differences in shell-characters between *P. jenningsi* and other species of Pisaniinae are in itself insufficient for a retention of *Sukunaia* as a genus-group.

Pisania luctuosa Tapparone-Canefri, 1875 (Figs. 12, 23-26, 33-34)

1875. *Pisania luctuosa* Tapparone-Canefri, Boll. Soc. Malac. Ital. 2:242 (Mauritius).

1880. *Pisania luctuosa* Tapparone-Canefri, Ann. Soc. Malac. Belg. 15(1) : 60, pl. 2, figs. 7-9.

1967. *Pisania fasciculata* (Reeve), Orr-Maes, Proc. Acad. Nat. Sci. Philad. 119(4) : 135, pl. 13, fig. A (non *Buccinum fasciculatum* Reeve, 1846) Cocos-Keeling I.

Shell moderately small, 12-20 mm in length, slender and elongate, width 42%-48% of length; blackish-brown or dark purple-black in colour, ornamented with a narrow, white peripheral band on body whorl from which short white lines extend in direction of suture; on penultimate whorl small white spots occasionally visible at suture. Teleoconch of $3\frac{3}{4}$ - $4\frac{1}{4}$ mature whorls in adult specimens, protoconch of 1 single turn immersed within teleoconch; in juvenile specimens teleoconch of 5 mature whorls and protoconch of 3 brown, axially striate nuclear whorls, with the initial turn white. Sculptured with numerous, fine and irregular spiral striae numbering 16-23 on penultimate whorl and 36-50 on body whorl some spirals more prominent than others and early whorls costate. Aperture narrow, equal in height or longer than spire, elliptical, bluish-white or light violet within, labial lip externally thickened and internally with 13-16 white denticles; the first 2-3 posterior denticles thickened and projecting, remaining denticles become progressively smaller towards siphonal canal. Columella calloused anteriorly, purplish-brown in colour, parietal wall with a distinct denticle, anterior of columella with a blunt projecting notch-like denticle; siphonal canal short but distinct.

The operculum (Fig. 24) is corneous, yellowish-brown in colour and with a dark brown axial zone, nucleus basal but indistinct. The rachidians of the radula (Figs. 23-25) are shortly rectangular, with a concave base and 5 cusps. The laterals are similar to *Pisania crenilabrum*, with a massive inward pointing inner cusp of variable length, and a small distinct or almost obsolete central cusp and a short, hooked back cusp. Sexual dimorphism was evident in the radulae of *P. luctuosa* (Table 1): the females have an appreciably shorter and narrow odontophore, but more numerous rows of teeth.

The living animal's dorsal side of the foot is creamy-white, mottled with blackish-brown, the sole of the foot is creamy-white and iridescent. The siphon is very long and a delicate shade of pink.

Pisania luctuosa is similar to *P.crenilabrum* A. Adams, with which species it is sympatric in Fiji and Mauritius, without any integrading specimens having been encountered. *Pisania luctuosa*, apart from the distinctive colour pattern, differs in features of small size, slender form, narrower aperture and more numerous spiral striae. The operculum of *P.crenilabrum* is uniformly fawn or light orange-brown in colour, and lacks the purplish-brown zones within the centre. The rachidians of the radula in *P.crenilabrum* are trapezoidal, with the sides ascending obliquely towards the base of the plate.

Pisania luctuosa has an Indo-Pacific distribution. Apart from the type locality of Mauritius, the species has been recorded by Orr-Maes (1967) from the Indian Ocean Cocos-Keeling Islands (as *P.fasciculata* Reeve). In the Fiji Islands the species has been collected at Rat Tail Passage, Sth. Viti Levu (leg. W. Cernohorsky), Tavarua I., W. Viti Levu (A. Jennings and W. Cernohorsky), and the Momi shore reef (A. Jennings). A specimen of *P.luctuosa* from Port Moresby, Papua & New Guinea (leg. F. Kleckham, intertidal on reef), has also been examined.

Table 1. Sexual dimorphism in the radulae of *Pisania luctuosa* Tapparone-Canefri.

Length of shell (mm)	Sex	Length of radula (mm)	Length of radula in % of shell length	Width of radula (mm)	Width of radula in % of shell length	No. of rows of teeth (nascentes in brackets)	No. of rows of teeth per 1mm of radula length	Locality
17.9	♂	13.0	73	0.50	2.8	118 (+ 7)	9.1	Tavarua Island
16.8	♂	12.1	72	0.44	2.6	120 (+ 8)	9.9	"
16.2	♂	10.7	66	0.44	2.7	102 (+ 5)	9.5	"
17.7	♀	10.1	57	0.34	1.9	146 (+ 8)	14.6	"
17.0	♀	9.0	53	0.28	1.6	147 (+ 8)	19.3	"
16.5	♀	8.7	53	0.32	1.9	144 (+ 6)	16.6	"
15.5	♀	9.2	59	0.29	1.9	153 (+ 9)	16.6	"
14.4	♀	8.0	55	0.26	1.8	148 (+ 7)	18.5	Momi reef
12.6	♀	7.8	62	0.24	1.9	146 (+ 10)	18.7	Port Moresby

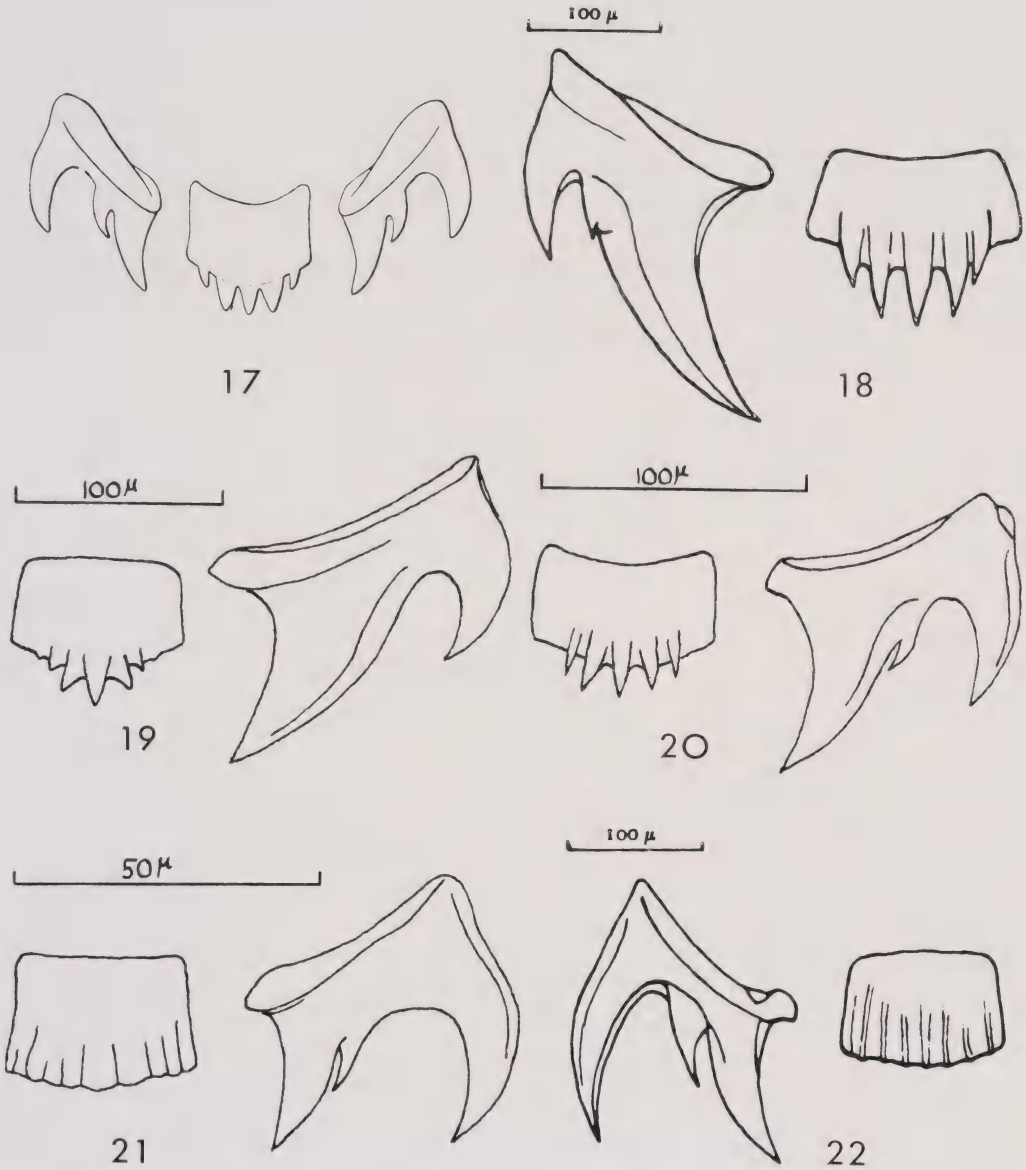
***Pisania gracilis* (Reeve, 1846)**

(Figs. 21, 32, 41-44)

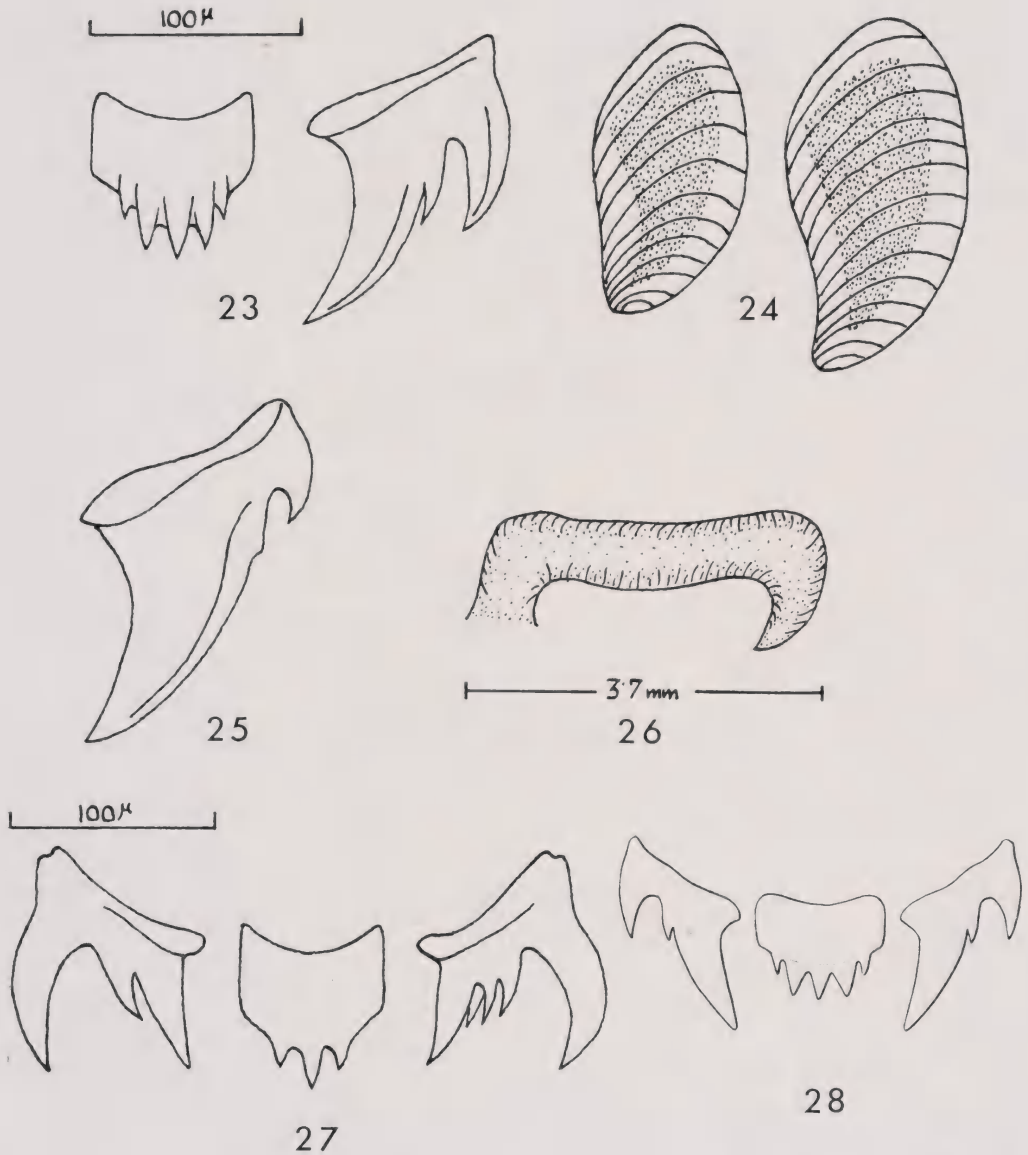
1846. *Buccinum marmoratum* Reeve, Conch. Icon., pl. 12, sp. 95 (Island of Capul, Philippines) [non Link, 1807; nec Anton, 1839].
1846. *Buccinum gracile* Reeve, Conch. Icon., pl. 12, sp. 96.
1846. ?*Buccinum crocatum* Reeve, Conch. Icon., pl. 12, sp. 97 (Island of Capul, Philippines).
1853. *Phos billeheusti* Petit de la Saussaye, J. Conchyl. 4(3) : 244, pl. 8, fig. 5 (Nukuhiva I., Marquesas Islands).
1967. *Pisania marmorata* (Reeve), Orr-Maes, Proc. Acad. Nat. Sci. Philad. 119(4) : 135, pl. 13, fig. B (non *Buccinum marmoratum* Link, 1807).

TYPE LOCALITY: Island of Masbate, Philippines.

The well-known Indo-Pacific species *Buccinum marmoratum* Reeve, is twice pre-occupied and will have to be replaced by *Buccinum gracile*. The three syntypes of *B.marmoratum* Reeve, are in the British Museum (Nat.Hist.),



Figs. 17-22. Radulae. 17. *Pisania striata* (Gmelin). Mediterranean. (From Troschel, 1867, pl. 7, fig. 2.) 18. *P. crenilabrum* A. Adams. Northwest I., Queensland, Australia. 19. *P. decollata* (Sowerby). Rat Tail Passage, Suva, Fiji I. 20. *P. (Ecmansis) ignea* (Gmelin). Rat Tail Passage, Suva, Fiji I. 21. *P. gracilis* (Reeve). Suva reef, Fiji I. 22. *P. jenningsi* (Cernohorsky). Naevuevu, Fiji I.



Figs. 23-28. Radulae. 23-26. *Pisania luctuosa* Tapparone-Canefri. Tavarua I., Fiji I. 23. Half-row of radula. 24. Opercula. 25. Lateral tooth of radula. 26. Penis. 27. *P. (Caducifer) truncata* (Hinds). Rat Tail Passage, Suva, Fiji I. 28. *Acamptochetus mitrella* (Adams & Reeve). Philippines. (From Troschel, 1867, pl. 7, fig. 10.)

London; they are large but immature specimens with not fully developed labial denticles and measure 32.2 mm, 31.4 mm and 25.6 mm in length. The largest specimen, i.e. 32.2 mm in length, which has been figured by Reeve (1846, pl.12, sp.95) is here selected as the lectotype of *B.marmoratum*. Slender and slightly broader individuals are found in all populations of *Pisania gracilis*, and immature specimens, such as Reeve's *Buccinum marmoratum*, are always disproportionately broad. *Phos billeheusti* Petit de la Saussaye, has been based on the slender form of *Pisania gracilis*.

The rachidians of the radula of *P.gracilis* (Fig. 21) has the same obsolete denticles as are found in *P.jenningsi*, while the laterals are of the same type as in *P.striata* (Gmelin). It is very doubtful that the radula of "*Engina(?)marmorata*" from the Seychelles Islands, as figured by Peile (1939, fig. 39) has been extracted from the species under discussion; both, rachidians and laterals, indicate that Peile's species was a typical *Engina*.

Pisania gracilis (Reeve), is the type species (as *P.billeheusti*) of *Prodotia* Dall, 1924; apart from the granose sculpture, there is little else on which to base a generic separation from *Pisania*. *Buccinum crocatum* Reeve, may prove to be only a colour variant of *Pisania gracilis*.

Subgenus **Ecmanis** Gistel, 1848

Ecmanis Gistel, 1848, Nat. Thierr. Schulen, p. 10. Type species (art. 67 (i) of ICZN) *Buccinum igneum* Gmelin, 1791. Recent, Indo-Pacific (*Nom. subst. pro Proboscidea* Schmidt in Möller, 1832).

1832. *Proboscidea* Schmidt in Möller, Isis, col. 131. Type species by M. *P. ignea* = *Buccinum igneum* Gmelin, 1791 (non *Proboscidea* Bruguière, 1791; nec Spix, 1824).

The shell is similar in form to *Pisania*, but thinner and more fragile and inflated, with the labial denticles obsolete in adult specimens. The operculum is light yellowish-brown in colour, with a basal nucleus. The radula (Fig. 20) is similar to the radula of *Pisania striata*, except that the inner cusp of the laterals is slightly longer. The subgenus appears to be monotypic, and is confined to the Indo-Pacific region.

Pisania (Ecmanis) ignea (Gmelin, 1791)

(Figs. 15, 20, 35)

1780. "*Triton buccinulum nitidissimum* Chemnitz", Syst. Conch. Cab. 4:72, pl. 127, fig. 1217 (*non binom.*) [Cape of Good Hope].

1791. *Buccinum igneum* Gmelin, Syst. Nat., ed. 13, pl. 3494 (ref. Chemnitz, *op. cit.*, fig. 1217 (Hab: ?)).

1798. *Trionium buccinulum* Röding, Mus. Bolten., p. 125 (ref. Chemnitz, *op. cit.*, fig. 1217).

1833. *Buccinum flammulatum* Quoy & Gaimard, Voy. Astrolabe 2: 426, pl. 30, figs. 29-31 (Tongatabu).

1846. *Buccinum pictum* Reeve, Conch. Icon., pl. 10, fig. 74 (Isle of Capul, Philippines).

TYPE LOCALITY: *None*. (Cape of Good Hope — Chemnitz, 1780).

This species differs from other *Pisania* species by its light weight in proportion to shell size and fragile appearance. In the most senile specimens, only the first posterior labial denticles are distinct, and are followed by 4-5 blunt, almost obsolete denticles which are indicated as swellings. The early whorls are prominently granulose, but the last two whorls have only obsolete spiral threads or grooves.

The radula of *Ecmanis ignea* as figured by Habe & Kosuge (1967, p.79, bottom figure), is appreciably different to the radula extracted from Fiji specimens (Fig. 20), and resembles the radula of *Engina*. The type locality of Cape of Good Hope may be an error, as the species does not appear to be listed in South African faunal records.

Subgenus **Caducifer** Dall, 1904

Caducifer Dall, 1904, Smiths. Misc. coll. 47:136. Type species by OD *Triton truncatus* Hinds, 1844. Recent, Indo-Pacific.

In sculpture and apertural features *Caducifer* is similar to *Pisania*, but differs in the slender, terebriform shape and short aperture. In adult specimens the protoconch is immersed in the teleoconch in a similar manner as in *Pisania decollata*, *P.crenilabrum* and *P.luctuosa*.

The radula of *Caducifer* (Fig. 27) is similar to the radula of *Pisania striata* (Gmelin), except that the rachidians have only 3 cusps instead of 5; the number of cusps on the laterals is variable, and fluctuates between 3 and 5.

Pisania (Caducifer) truncata (Hinds, 1844)

(Figs. 16, 27)

1844. *Triton truncatus* Hinds, Proc. Zool. Soc. Lond. 12:21.

1844. *Triton truncatus* Hinds, Zool. Voy. Sulphur 2: pl. 4, figs. 9, 10.

1844. *Triton decapitatus* Reeve, Conch. Icon., pl. 18, sp. 85 (Island of Burias, Philippines).

1868. *Triton cylindricus* Pease, Amer. J. Conch. 4(3): 94, pl. 11, fig. 8. (Tahiti).

1904. *Tritonidea (Caducifer) decapitata* (Reeve), Pilsbry & Vanatta, Proc. Acad. Nat. Sci. Philad. 56:594, fig. 4 (radula).

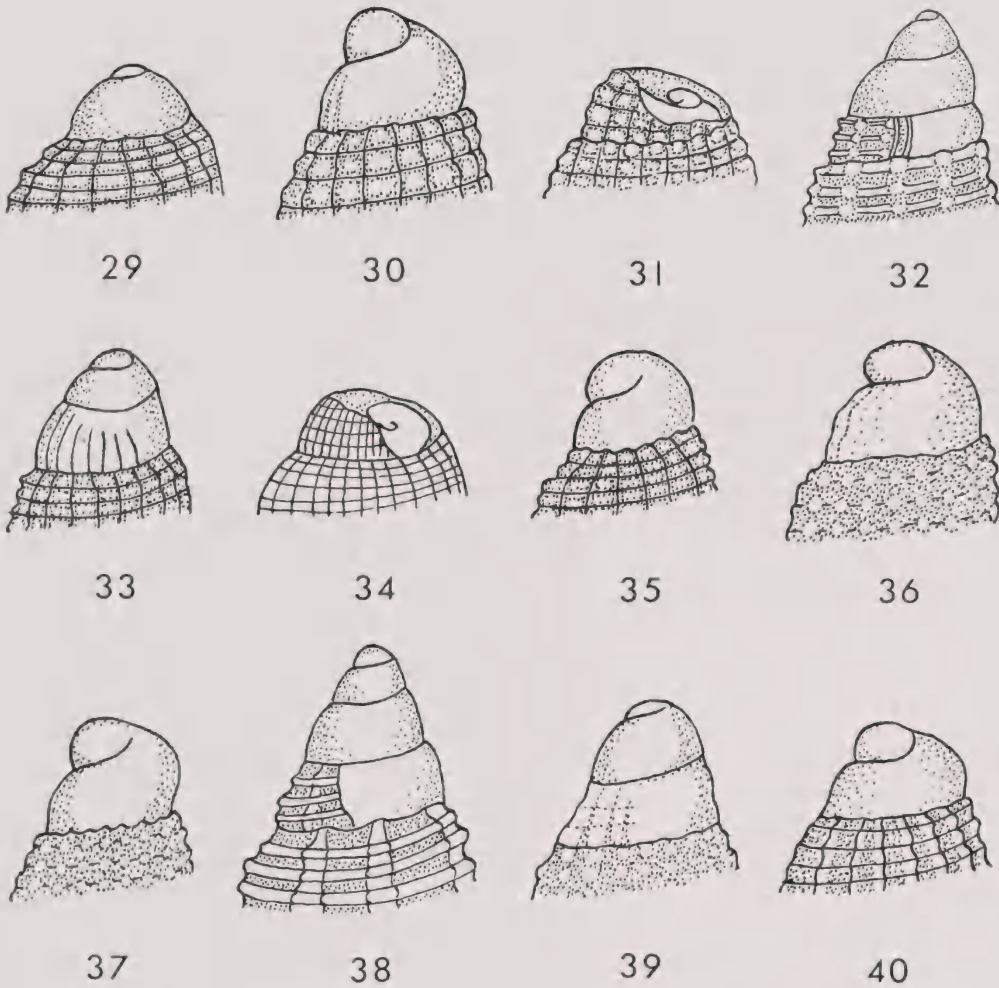
TYPE LOCALITY: New Ireland.

The species is closely allied to the *Pisania* group of species, but is more terebriform, the aperture is shorter and the labial denticles are fewer in number and more widely spaced. The species is variable in colour, but is generally leaden-grey or brown, and ornamented with spiral and axial white lines.

Subgenus **Jeannea** Iredale, 1912

Jeannea Iredale, 1912, Proc. Malac. Soc. Lond. 10:220. Type species by OD *J.hedleyi* Iredale, 1912. Recent, Kermadec Islands.

The type species is very similar to other tropical *Pisania* species, and differs only in the smaller, weaker and slightly more numerous labial denticles. The operculum is yellowish-orange in colour, with a basal nucleus. Most specimens of



Figs 29-40. Protoconchs. 29. *Pisania striata* (Gmelin). 30. *P. crenilabrum* A. Adams (juvenile). 31. *P. decollata* (Sowerby). 32. *P. gracilis* (Reeve). 33, 34. *P. luctuosa* Tapparone-Canefri. 33. Juvenile. 34. Adult. 35. *P. (Ecmansis) ignea* (Gmelin). 36. *Cantharus (Pollia) undosus* (Linnaeus). 37. *C. (P.) subrubiginosus* (E. A. Smith). 38. *C. (P.) pulcher* (Reeve). 39. *Engina alveolata* (Kiener). 40. *Jeannea hedleyi* Iredale.

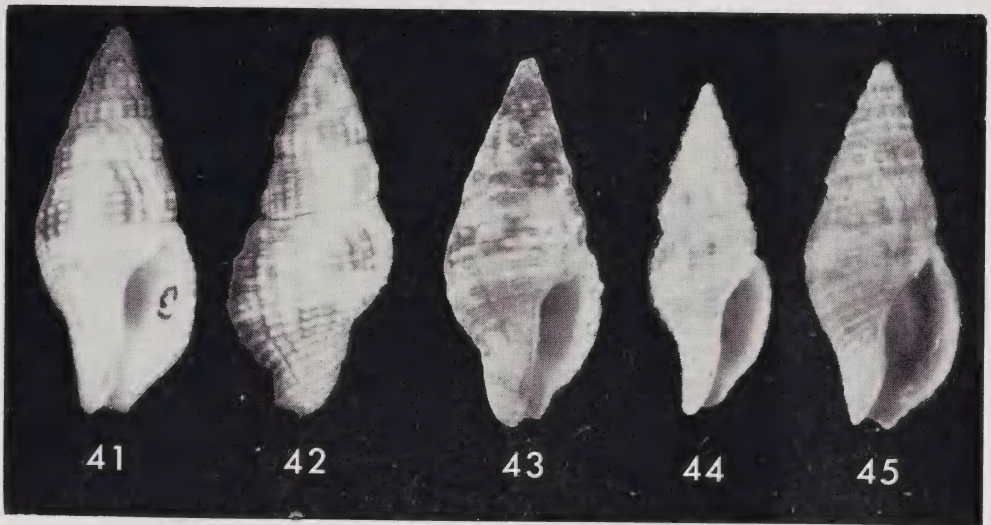
Pisania(Jeannea)hedleyi (Figs. 40,45) also retain their protoconch in the adult stage.

Because of the close conchological resemblance of *P. (J.) hedleyi* to other *Pisania* species, *Jeannea* is retained as a subgenus pending the availability of a radula for examination.

THE METULA-RATIFUSUS SERIES

Genus **Metula** H. & A. Adams, 1853

Metula H. & A. Adams, 1853, Gen. Rec. Moll. 1: 84. Type species by SD (Kobelt, 1876)



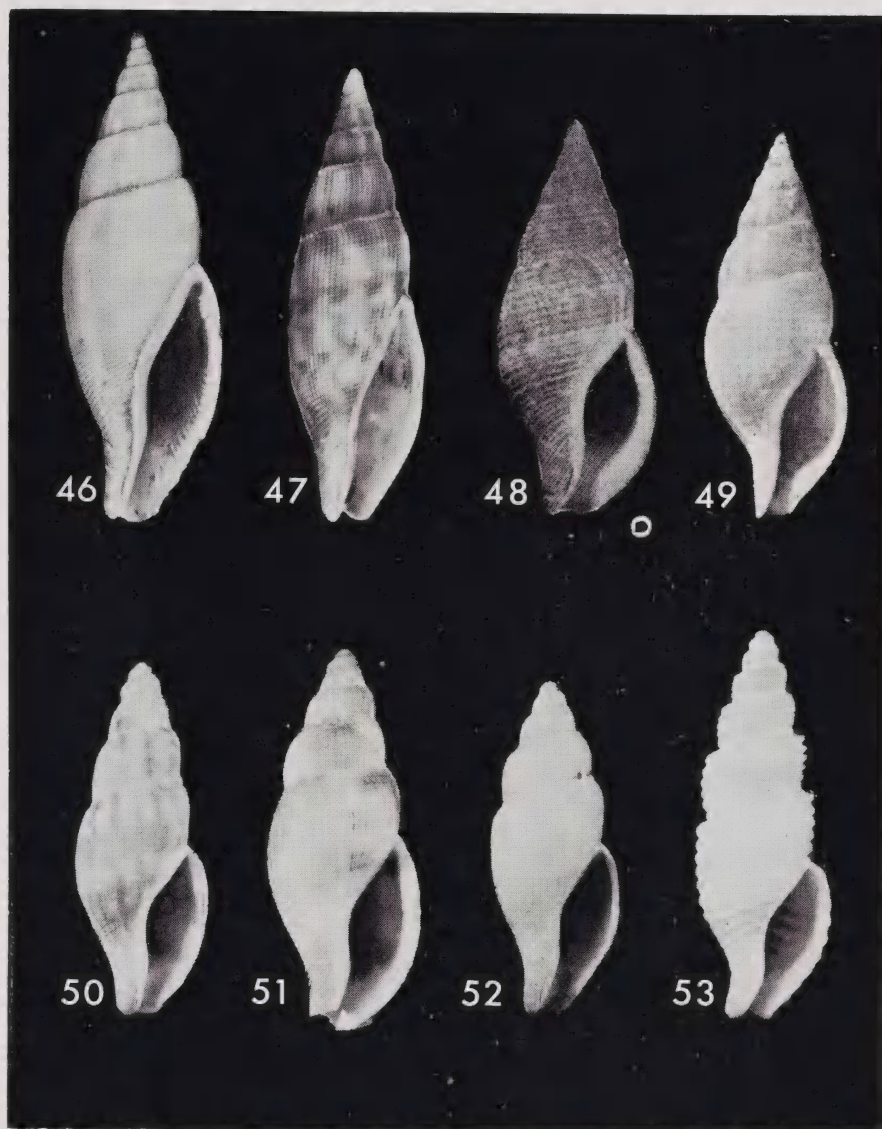
Figs. 41-45. Shells. 41-44. *Pisania gracilis* (Reeve). 41. Lectotype of *Buccinum marmoratum* Reeve, Island of Capul, Philippines; B.M.N.H., length 32.2mm. 42. Syntype of *B. marmoratum* Reeve, B.M.N.H.; length 31.4mm. 43. *Pisania gracilis* (Reeve). Rat Tail Passage, Suva, Fiji I., intertidal; length 19.3mm (broad form). 44. *P. gracilis* (Reeve). Rat Tail Passage, Suva, Fiji I., intertidal; length 17.6mm (slender form). 45. *Jeaneia hedleyi* Iredale. Kermadec Islands; length 11.8mm.

M.clathrata Adams & Reeve = *Buccinum clathratum* Adams & Reeve, 1850 (non Kiener, 1834; nec Anton, 1839). Recent, Cape of Good Hope, Sth. Africa (error! – fide Tomlin, 1927 = Gorgona I., off the Colombian coast, W. coast America).

Keen (1958) and Woodring (1964) considered *Buccinum metula* Hinds, to be the type species by hidden tautonymy. The current edition of the Code does not provide for a type designation by hidden tautonymy, and since *Buccinum metula* was not an originally included species (art. 68(d)) of ICZN), a type designation by tautonymy must be excluded.

Rehder (1943) treated the *Metula* problem in detail, and proposed *Antemetula* for the *Metula* auct. with *Buccinum metula* Hinds, as the type species. *Antemetula* Rehder, is in the opinion of the present author congeneric with *Acamptochetus* Cossmann, 1901.

The status of *Metula* depends on whether the species assigned to *Acamptochetus* and *Metula* are generically distinct, and also what the identity of *Buccinum clathratum* Adams & Reeve, the type species of *Metula*, really is. *Buccinum clathratum* Adams & Reeve, was originally described from the Cape of Good Hope, but Tomlin (1927) considered this locality erroneous, and confirmed the species occurrence from off the Columbian coast and Balboa. Keen (loc. cit), however, omitted the species from the West American fauna, and as far as could be ascertained, the species has remained unfigured since its description. The original describers provided a moderately reasonable figure of a species which could be referable to *Metula* as presently understood. This particular figure bears a great resemblance in form, sculpture and apertural features to the Miocene *Metula gabbi* Brown & Pilsbry, from the Panama Canal Zone, as figured by Woodring (1964, pl. 40, figs. 18, 19), except that the sculpture in the Miocene species is



Figs. 46-53. Shells. 46. *Acamptochetus mitraeformis* (Brocchi). Piedmont, U. Miocene of Italy; length 39.4mm. 47. *A. mitrella* (Adams & Reeve). Tayabas Bay, Marinduque, Philippine I., deep water trawl; length 31.5mm. 48. *Bartschia significans* Rehder. Off the Tortugas, Florida; length 54.5mm (from Rehder, 1943, pl. 20, fig. 17). 49. *Kanamarua adonis* (Dall). Enshu-nada, Japan (from Oyama & Takemura, 1958, pl. 19, fig. 3). 50. *Ratifusus adjunctus* Iredale. Off Aldermen I., New Zealand, in 200-260f (366-476m); length 19.0mm. 51. *R. reticulatus* (A. Adams). Off Schooner Bay, Gt Barrier I., New Zealand, in 15 fathoms (27m); length 21.0mm. 52. *R. (Iredalula) striatus* (Hutton). Bay of Plenty, New Zealand, deep water trawl; length 17.8mm. 53. *R. (Iredalula) alticinctus* (Murdoch & Suter). Off Aldermen I., New Zealand, in 260f (476m); length 21.5mm.

somewhat finer. Only an examination of Adams & Reeve's type of *Buccinum clathratum* and Tomlin's specimens of the species from West America, may help to elucidate the status of *Metula* and *Buccinum clathratum*, which, to complicate matters, is twice pre-occupied.

The *Metula* - *Acamptochetus* group of species is characterized by slender, elongate-ovate to fusiformly-ovate shells, which have a finely granose sculpture consisting of intersecting spirals and axials, and occasionally a cingulate or smooth thread at the sutures; the aperture is narrow and fusiform, the labial denticles are either obsolete or distinct and elongate, and the columella is smooth and has a narrow callus; in some species, whorls have adpressed, growth-varices.

The genus *Bartschia* Rehder, 1943 (type species *B. significans* Rehder, 1943 — Florida-Caribbean), should be located in the Pisaniinae, near the *Metula* group. *Monostiolum* Dall, 1904 (type species *Triton swifti* Tryon — Caribbean), should be removed from the Colubrariidae and located in the Buccinidae, possibly the Pisaniinae subfamily.

Genus *Acamptochetus* Cossmann, 1901

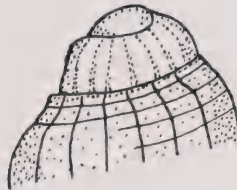
Acamptochetus Cossmann, 1901, Ess. paléoc. comp. 4:123. Type species by OD *Murex mitraeformis* Brocchi, 1814. Mio-Pliocene of Europe.

1943. *Antemetula* Rehder, 1943, Proc. U.S. Nat. Mus. 93:199. Type species by OD *Buccinum metula* Hinds, 1844. Recent, W. coast of Panama.

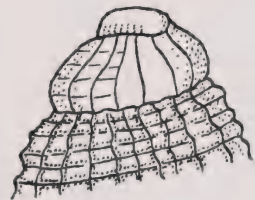
Acamptochetus is a typical *Metula* auct. = *Antemetula* Rehder, 1943. Shells are elongate-ovate or fusiformly-elongate, the sculpture is generally cancellate but spirals may predominate, the sutures have a smooth or cingulate spiral thread and whorls frequently have flat, adpressed and often obsolete growth-varices. The aperture is narrow and fusiform, the labial lip is finely or obsoletely denticulate, the columella has a smooth and narrow callus and the canal is moderately short.



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Figs. 54-58. Protoconchs. 54. *Acamptochetus mitrella* (Adams & Reeve). 55. *Ratifusus adjunctus* Iredale. 56. *R. reticulatus* (A. Adams). 57. *R. (Iredalula) striatus* (Hutton). 58. *Buccinulum lineatum* (Gmelin).

The present author has failed to find a single constant diagnostic character which would allow an easy separation of *Antemetula* from *Acamptochetus*. *A. mitraeformis* (Fig. 46) is a larger species than *A. metula* but the West American *A. amosi* (Vanatta) and the Philippine *A. mitrella* are about the same size as the Mio-Pliocene *A. mitraeformis*. The stratigraphical range of *Acamptochetus* is from the Oligocene to the Recent.

Acamptochetus mitrella (Adams & Reeve, 1850) (Figs. 28,47,54)

1850. *Buccinum mitrella* Adams & Reeve, Zool. Voy. Samarang, p. 32, pl. 11, fig. 13.

1966. *Antemetula mitrella* (Adams & Reeve), Habe & Kosuge, Shells world col. 2:41, pl. 15, fig. 2.

TYPE LOCALITY: China Sea; 10 fathoms (18.3 m).

This species is a typical *Acamptochetus*: the sculpture consists of fine spiral and axial threads, with *c.* 25 spirals on the penultimate and 50 spirals on the body whorl, the sutures are bordered by a fine cingulate thread and the aperture is narrow and fusiform. The labial denticles are small but slightly elongate, and the columella is calloused and smooth. The protoconch has 3 smooth whorls, the teleoconch 6-7 whorls; whorls carry flat, adpressed and sometimes obsolete growth varices which are generally spaced at 80° to 100° intervals, with the exception of the body whorl where generally only the labial varix is present. Similar growth varices are also present in the genus *Ratifusus* Iredale.

The radula (Fig. 28) of *A. mitrella* as figured by Troschel (1867), is very similar to the radula of tropical Pisaniinae. Troschel's radula figure needs of course confirmation.

Genus ***Ratifusus*** Iredale, 1929

Ratifusus Iredale, 1929, Rec. Aust. Mus. 17(4): 183. Type species by *M. R. adjunctus* Iredale, 1929. Recent, S.E. Australia and New Zealand.

Ratifusus is similar in many features to species of the *Metula-Acamptochetus* group: the sculpture consists of numerous fine spiral threads and axial growth striae, but is more discreet than in either *Metula* or *Acamptochetus*. The protoconch, however, has only 1½ to 2 small and depressed nuclear whorls, the varices are indefinite, flat and adpressed and similar to those in *Acamptochetus mitrella* and *A. mitraeformis*; the radula of *Ratifusus* is appreciably different than the radula of *Acamptochetus*.

Ponder (1968) figured the radulae of *Ratifusus* and *Iredalula*, and showed that the two genera should be re-located in the family Buccinidae, and not that the Colubrariidae are a Buccinacean family. Three large specimens of the type species of *Colubraria*, i.e. *C. maculosa* (Gmelin, 1791) [= *muricata* Lightfoot, 1786] have been examined, and the animal was found to be devoid of a radula. Dr. T. Habe (*in litt.* 2-2-1967), informed the writer that he was also unable to recover a radula from *Colubraria*; it is further significant that no radula of a typical *Colubraria* has been published to date. The absence of a radula in the Colubrariidae indicates that species of the group are edentulous suctorial feeders. The varices in Colubrariidae are thick, swollen and angulate, and placed approxi-

mately at 180° intervals on the whorls, and are appreciably different to the flat, adpressed and often obsolete growth-varices found in several buccinid genera. Similar buccinid growth varices may also be found in certain Thaidine genera, and may also be observed in the Caribbean Miocene buccinid genus *Cymatophos* Pilsbry & Olsson; these varices are clearly visible in illustrations supplied by Jung (1965, pl. 71, figs. 6-8 and pl. 72, figs. 1-2), and Woodring (1964, pl. 41, figs. 3, 5, 8, 13).

The Austral-Neozelanic species *Ratifusus reticulatus* (A. Adams, 1855) (Figs. 51, 56, 60) is not a secondary homonym of *Colubraria reticulata* (Blainville, 1829), and Iredale's substitute name *Fusus mestayerae* Iredale, 1915, is therefore superfluous. *Ratifusus reticulatus*, which belongs in the Buccinidae, was described in the genus *Pisania*, and *Colubraria reticulata*, a member of the Colubrariidae, was described in the genus *Tritonium*.

Dall's (1906) designation of *Murex (Fusus) intertextus* Helbling, 1779 (a prior name for *Colubraria reticulata*) as the type species of *Fusus* Helbling, 1779, presents taxonomic problems. The Mediterranean species *M.(F.) intertextus* Helbling (= *reticulata* Blainville) is unquestionably a *Colubraria*, and as the type species of *Fusus* Helbling, would have priority over *Colubraria* Schumacher, 1817.

In New Zealand, *Ratifusus* dates back to the Upper Eocene (Maxwell, 1966). The species *Colubraria neozelanica* Maxwell, 1966, from McCullough's Bridge, (Kaiatan), U.Eocene of New Zealand, is a *Ratifusus* and not a *Colubraria*.

Genus **Iredalula** Finlay, 1926

Iredalula Finlay, 1926, Trans. Proc. N.Z. Inst. 56: 231. Type species by OD *Bela striata* Hutton, 1873. Pleistocene and Recent, New Zealand.

Ponder (1968) acknowledged the close relationship of *Ratifusus* and *Iredalula* in features of anatomy, shell form, sculpture and protoconch, but pointed out differences in the lack of varices and labial denticles in *Iredalula*. Several specimens of *I. striata* (Hutton) were examined, and 4 flat varices were observed in a specimen from the Bay of Plenty, 5 varices in a specimen from Cuvier Island and 1 varix in a specimen from the Hauraki Gulf. In *I. alticincta* (Murdoch & Suter) the varices were found to be obsolete, and took on the form of overlapping axial lines which may resemble repair marks; similar indistinct varices or rest-period marks have also been observed in some specimens of the South African *Afrocominella elongata* (Dunker).

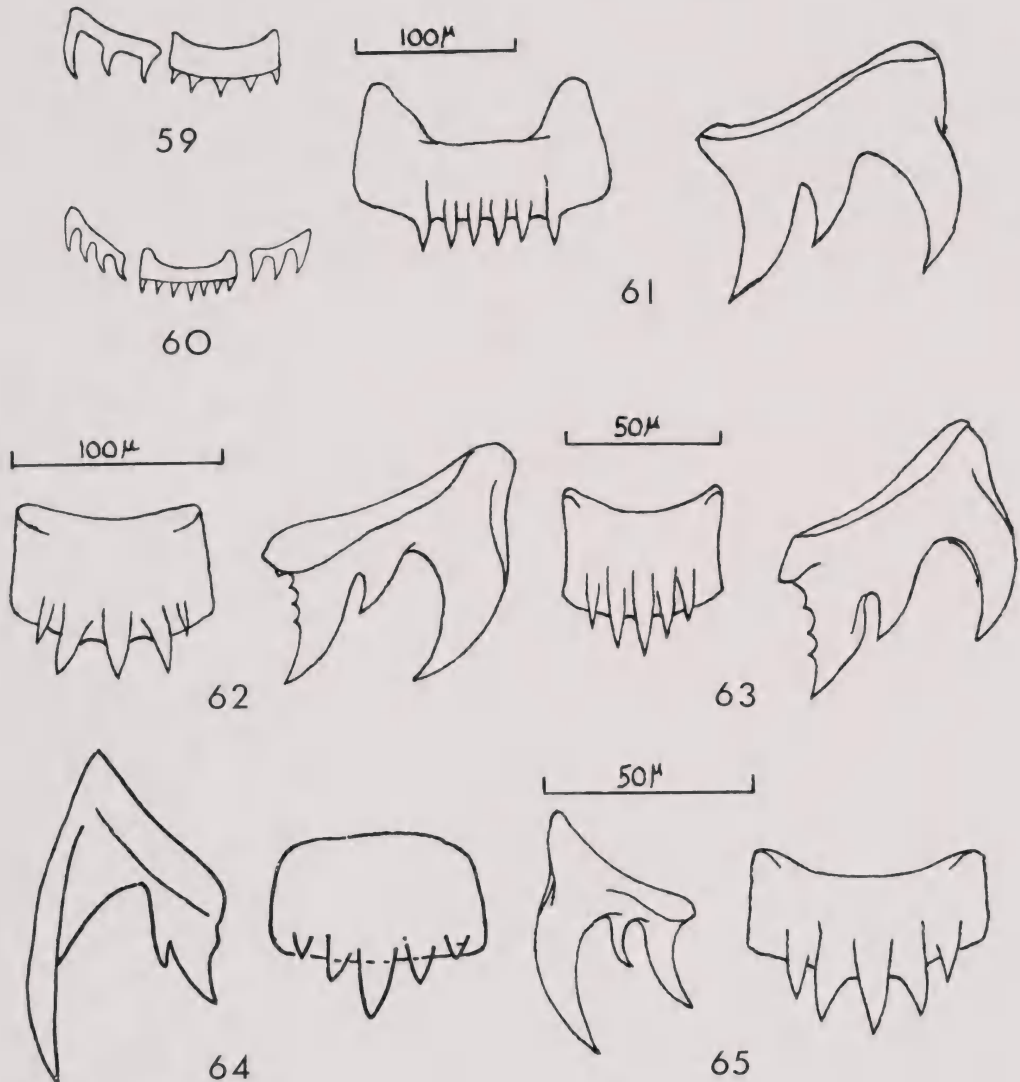
In *Ratifusus adjunctus* the labial lip is either smooth (described as "quite smooth inside" by Iredale, 1929), or finely serrated, whereas in *Iredalula striata* the labial lip is generally smooth; in some specimens of *I. alticincta*, however, the labial lip is bluntly denticulate and the aperture lirate within. It is therefore difficult to perceive on what basis *Ratifusus* and *Iredalula* are generically separable, when diagnostic features of one group are also represented in the other.

Kanamarua Kuroda, 1951 (type species *Colus (Aulacofusus) adonis* Dall from Japan) should also be located in the *Metula-Ratifusus* group; the type species resembles *Ratifusus* more than it does *Metula* or *Acamptochetus*.

Genus *Cantharus* Röding, 1798

Cantharus Röding, 1798, Mus. Bolten., p. 132. Type species by SD (Cossmann, 1901).
Buccinum tranquebaricum Gmelin, 1791. Recent, Indian Ocean.

1807. *Nassaria* Link, Besch. Nat.-Samml. Univ. Rostock 3 Abth., p. 123. Type species by SD (Dell, 1967) *N. tranquebarica* Link = *Buccinum tranquebaricum* Gmelin, 1791.



Figs. 59-65. Radulae. 59. *Ratifusus (Iredalula) striatus* (Hutton). Between Cape Runaway and Ohiwa Harbour, New Zealand (from Ponder, 1968, fig. 9). 60. *R. reticulatus* (A. Adams). Bay of Islands, New Zealand (from Ponder, 1968, fig. 7 — as *R. mestayerae* Iredale). 61. *Japeuthria ferrea* (Reeve). Minoshima, Wakayama, Japan. 62. *Cantharus (Pollia) undosus* (Linnaeus). Nadroga reef, Korotogo, Fiji I. 63. *C. (P.) subrubiginosus* (E. A. Smith). Nananu-i-Ra I., Fiji I. 64. *Engina turbinella* (Kiener). Buccoo reef, Tobago I., B.W.I. (from Orr, 1962, textfig.). 65. *E. alveolata* (Kiener). Viti Levu Bay, Fiji I.

1834. *Pusio* Griffith & Pidgeon, Anim. Kingd. Moll. Rad. Cuvier 12: pl. 25, fig. 2. Type species by SD (Gray, 1847) *P.elegans* = *Triton (Pusio) elegans* Griffith & Pidgeon., 1834. Recent, W. coast America.
1953. *Gemophos* Olsson & Harbison, Acad. Nat. Sci. Philad. Mon. No. 8: 225. Type species by OD *Buccinum gemmatum* Reeve, 1846. Recent, W. Coast America.

Subgenus **Pollia** Gray in Sowerby, 1834

Pollia Gray in Sowerby, 1834, Gen. Rec. Foss. shells 2: footnote to *Purpura*, pl. 237, fig. 12. Type species by M *Triton undosus* Lamarck = *Buccinum undosum* Linnaeus, 1758. Recent, Indo-Pacific.

1840. *Tritonidea* Swainson, Treat. Malac., p. 302. Type species by SD (Gray, 1847) *T.undosus* = *Buccinum undosum* Linnaeus, 1758).

It is somewhat problematical whether *Cantharus*, *Pollia*, *Hanetia* and *Engina* should be placed in either the subfamily Pisaniinae or Photinae, or in a separate subfamily Cantharinae as Iredale intended (1940) through his proposition of Pusiostomatidae. Iredale's family-group is not applicable to the Buccinidae as the type genus *Pusiostoma* Swainson, belongs in the Columbelloidea.

Species of *Pollia* differ from *Cantharus* in having convex whorls which are not angulate on the presutural ramp. The radula of the type species of *Cantharus* remains unknown, but the radulae of tropical *Pollia* are basically similar to the radula of *Pisania striata*, except that the inward facing edge of the inner cusp of the lateral is always serrated. Robertson (1957), figured radulae of American *Cantharus* species which are even more similar to the radula of *Pisania striata* in that they lack the serrations of the inner cusp.

Species of *Engina* are easily separated from the *Cantharus-Pollia* group of species: in *Engina* the entire columella is calloused and the columella denticles reach as high as the parietal wall; the interior of the columella is projecting, with the projection occasionally bifurcate as in Columbelloidea. In *Cantharus*, the columellar callus becomes thin in the centre of the columella, where only the body whorl sculpture is visible; the bifurcate columella projection is also lacking.

Cantharus (Pollia) undosus (Linnaeus, 1758) (Figs. 36,62,66)

1758. *Buccinum undosum* Linnaeus, Syst. Nat. ed. 10, p. 740.

1791. *Buccinum affine* Gmelin, Syst. Nat. ed. 13, p. 3490.

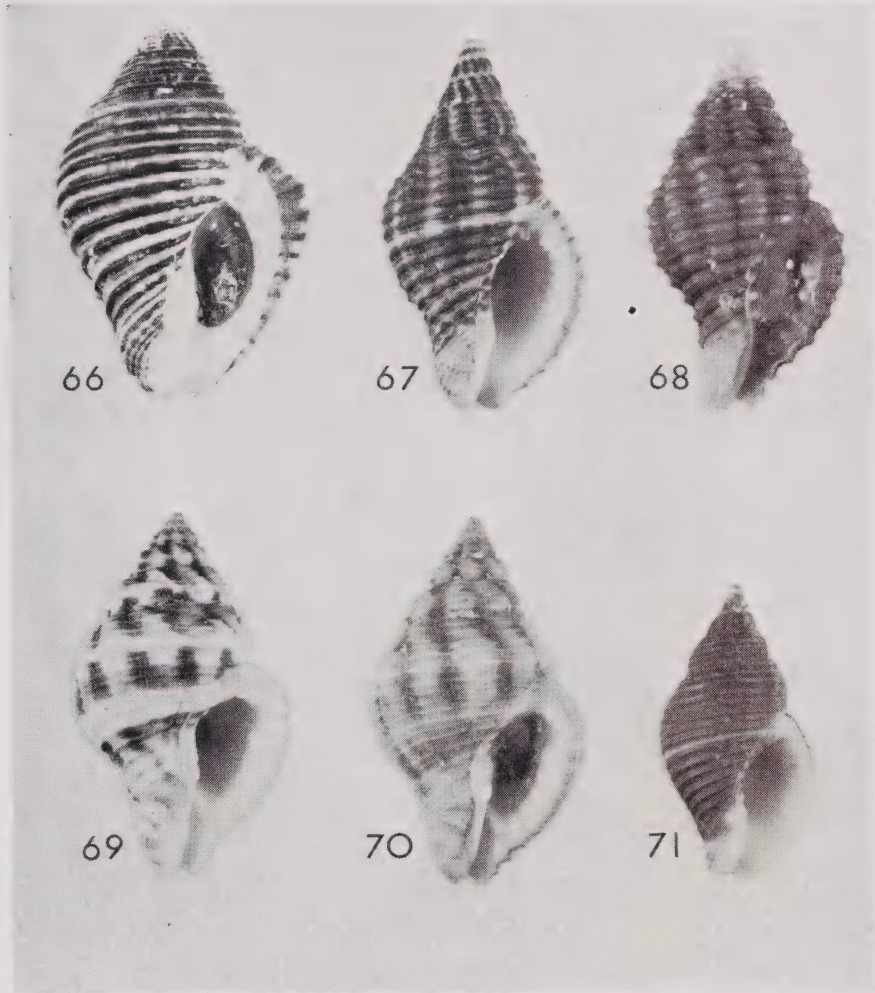
TYPE LOCALITY: Asia.

In large specimens of *C.undosus* the shell is strongly spirally corded, without axial ribs, and the labial lip is angulate posteriorly. Small specimens of *C.undosus* are frequently axially costate all the way to the body whorl, and the labial lip is regularly convex; these specimens can be separated from *C.fumosus* only with difficulty. The radula (Fig. 62) has laterals with a serrated inner cusp.

Cantharus (Pollia) fumosus (Dillwyn, 1817) (Fig. 67)

1817. *Buccinum fumosum* Dillwyn, Descr. cat. shells 2: 629 (ref. Chemnitz, Vol. 4, pl. 123, upp. figs. 1145-46).

1846. ?*Buccinum rubiginosum* Reeve, Conch. Icon. 3: pl. 7, fig. 47 (Red Sea).



Figs. 66-71. Shells. 66. *Cantharus (Polia) undosus* (Linnaeus). Korotogo, Fiji I., intertidal; length 32.8mm. 67. *C. (P.) fumosus* (Dillwyn). Manava I., Fiji I., intertidal; length 22.8mm. 68. *C. (P.) pulcher* (Reeve). Manava I., Fiji I., intertidal; length 19.8mm. 69, 70. *C. (P.) wagneri* (Anton). Malolo Barrier reef, Mamanuca group, Fiji I., intertidal. 69. Length 28.0mm (without periostracum). 70. Length 22.8mm (with periostracum). 71. *C. (P.) subrubiginosus* (E. A. Smith). Nananu-i-Ra I., Fiji I., intertidal; length 15.8mm.

1846. *Buccinum proteus* Reeve, Conch. Icon. 3: pl. 7, fig. 51 (Ceylon, Philippines & Australia).

TYPE LOCALITY: None.

The species is similar to *C. undosus*, except that the axial ribs are well developed on later whorls; the interstices of the spiral cords are axially striated in both species. It is suspected that *C. fumosus* is only an individual or developmental form of *C. undosus*.

Cantharus (Pollia) wagneri (Anton, 1839) (Fig. 69-70)

1829. *Turbinella craticulata* var. B. Schubert & Wagner, Syst. Conch. Cab. 12:103, pl. 227, figs. 4023-24 (non *Murex craticulatus* Linnaeus, 1758).
 1839. *Turbinella wagneri* Anton, Verz. Conchyl., p. 71 (nom. nov. pro. *Turbinella craticulata* var. b. Schubert & Wagner, 1829).
 1847. *Turbinella crenulata* Reeve, Conch. Icon. 4: pl. 4, sp. 24 (non Kiener, 1840).

TYPE LOCALITY: None. (Isle of Capul, Philippines — Reeve, 1847).

The species is creamy-white to yellowish in colour, the spiral cords are orange-brown and the body whorl has 3 spiral rows of purple spots which are situated in the interstices of the axial ribs. The operculum is yellowish-brown, with a basal nucleus; the periostracum is brown and opaque.

Cantharus (Pollia) pulcher (Reeve, 1846) (Fig. 38,68)

1846. *Ricinula pulchra* Reeve, Conch. Icon. 3: pl. 3, figs. 20 a,b (August 1846).
 1879. ?*Peristernia elegans* var. *papuensis* Tapparone-Canefri, J. Conchyl. 27:325 (Port Dorey, New Guinea).
 1959. *Engina purchra* (*sic*) (Reeve), Kira, Col. Illust. shells Japan 1: 66, pl. 26, fig. 3.

TYPE LOCALITY: Island of Capul, Philippines.

The species is reddish-brown and shining, the interstitial spiral grooves are dark brown, the siphonal canal, nuclear whorls and aperture are rosy-pink in colour, the siphonal canal is produced and the axial ribs are close-set.

Habe & Kosuge (1967) located the species in *Engina*, but the species lacks the calloused columella, denticles along its entire length and the projecting interior of the columella. Tapparone-Canefri (1879) synonymized *Cantharus pulcher* with *Turbinella elegans* Dunker in Küster, but the description and figure of the latter associate the species with *Engina incarnata* (Deshayes in Laborde & Linant).

Cantharus pulcher (Reeve) may have at times been confused with the West American *Engina pulchra* (described as *Buccinum pulchrum* Reeve — December 1846), which is a typical *Engina* and not a *Cantharus*.

Cantharus (Pollia) subrubiginosus (E. A. Smith, 1879) (Figs. 37,63,71)

1879. *Tritonidea subrubiginosa* E. A. Smith, Proc. Zool. Soc. Lond., p. 206, pl. 20, fig. 40.

TYPE LOCALITY: Ukushima, Goto Islands, Japan; among rocks at low water.

The species is small, 10-17 mm in length, nuclear whorls are smooth, light brown, with the initial turn white; the shell is uniformly dark reddish-brown in colour with a narrow, white central band on the body whorl. The spiral cords are regular, thin and elevated, interspaces are broader than the threads and sculptured with fine interstitial spiral lirae and obsolete axial growth striae. The early whorls are axially ribbed, the last two whorls are smooth or obsoletely costate. The aperture is bluish-white, the labial lip has 12 elongated denticles which continue as lirae into the aperture, the anterior of the columella is white and has 1-3 small denticles; the centre of the columella is brownish, the parietal wall is calloused and

has a small denticle. The radula (Fig. 63) has laterals with a serrated inner cusp; the periostracum is brown and moderately translucent.

Fijian specimens of *Cantharus subrubiginosus* agree with the original description in every detail. Specimens of *C.natalensis* (E.A.Smith, 1901) from South Africa examined, were found to be very similar to the Fijian examples of *C.subrubiginosus*. In the Fiji Islands, *C.subrubiginosus* lives among coarse weed on the underside of coral rocks in the intertidal zone.

Genus *Engina* Gray, 1839)

Engina Gray, 1839, Zool. Capt. Beechey's Voy. Blossom, p. 112. Type species by SD (Gray, 1847) *Enzina zonata* Gray, 1839 = *Purpura turbinella* Kiener, 1836. Recent, Caribbean.

1847. *Enzina* Gray, Proc. Zool. Soc. Lond., p. 133 (nom. null.).

1940. *Enzinopsis* Iredale, Aust. Zool. 9:434. Type species by OD *E.gannita* Hedley = *Engina gannita* Hedley, 1915. Recent, Torres Straits.

Species of *Engina* are superficially similar to *Cantharus* and *Pollia*, but the aperture is narrower, the siphonal canal shorter, the columella is calloused and denticulate along its entire length and the interior of the columella is projecting and often bifurcate.

The radula (Figs. 64-65) has pentacuspoid rachidians, and the laterals are either bicuspid or tricuspid; the outer cusp of the laterals is very long and slender. Tropical *Engina* live either under basal rocks at the high tide level or under coral rocks of the intertidal zone.

Engina alveolata (Kiener, 1836) (Figs. 39,65,76-77)

1836. *Purpura alveolata* Kiener, Spéc. gén. icon. coq. viv., p. 42, pl. 9, fig. 23. (Hab:?).

1846. *Ricinula lauta* Reeve, Conch. Icon. 3: pl. 4, fig. 24 (Hab:?).

1846. *Ricinula histrio* Reeve, Conch. Icon. 3:pl. 5, fig. 36.

1865. *Engina fusiformis* Pease, Proc. Zool. Soc. Lond. p. 513 (Central Pacific).

1868. *Engina fusiformis* Pease, Amer. J. Conch. 3: 273, pl. 23, fig. 5 (Howland I.).

1965. *Engina fusiformis* Pease, Kay, Bull. Brit. Mus. (Nat. Hist.), Zool. Suppl. 1: 81, pl. 13, figs. 15, 16 (figd. lectotype).

TYPE LOCALITY: *None*. (Island of Ticao, Philippines — for *histrio* Reeve).

The shell is white in colour, ornamented with double rows of black nodules and intermediate rows of reddish-orange nodules; the columella is reddish-brown, denticulate, and liriate on the parietal wall. The operculum is small, translucent yellowish-brown with a dark brown central zone and a basal nucleus. The radula (Fig. 65) has pentacuspoid rachidians and tricuspid laterals.

The reddish-orange nodules are occasionally missing in some individuals, and it is this form on which *Purpura alveolata* was based. The species is rather common throughout the Pacific; specimens will reach 25.0 mm in length.

Engina zonalis (Lamarck, 1822) (Figs. 72-75)

1817. *?Voluta nana* Dillwyn, Descr. Cat. rec. shells 1536 (ref. Martini, Vol. 2, pl. 44, fig. 459) [Mediterranean].

1822. *Colombella zonalis* Lamarck, Hist. nat. anim. s. vert. 7:297 (Hab:?).
1846. *Ricinula zonata* Reeve, Conch. Icon. 3: pl. 5, sp. 33 (non *Engina zonata* Gray, 1839) [Charles I., Galapagos Islds. — error!].
1928. *Engina melanozona* Tomlin, Nautilus 42 (2): 40 (nom. subst. pro *Ricinula zonata* Reeve, 1846).
1938. *Engina zonata* Reeve, Adam & Leloup, Mem. Mus. Roy. Hist. Nat. Belg. 2(19): 178, pl. 8, fig. 2 (non Gray, 1839).
1967. *Engina melanozona* Tomlin, Orr-Maes, Proc. Acad. Nat. Sci. Philad. 119 (4), 135, pl. 12, fig. E.

TYPE LOCALITY: None. (New Caledonia, Tomlin, 1928).

The species is white, the spiral zones are black and may be interrupted by white nodules; the aperture is mauve or dark reddish-brown, and the siphonal canal has short wavy lines.

The figure from Martini (1773) cited for *Voluta nana* Dillwyn, is a miniature reproduction of a species which could possibly be identical with *Engina zonalis*. Martini (loc.cit.) described the species as being banded with black and white and reported its occurrence in the Mediterranean; the short description and erroneous locality raise some doubt about the species identity, which could be either *E.zonalis* or *E.lineata* Reeve.

Lamarck's holotype of *Colombella zonalis* is in the Muséum d'Histoire Naturelle, Geneva, No. 1102/40: length 9.6 mm; another 5 paratypes are in the same collection. Lamarck's types of *C.zonalis* are the same species as *Ricinula zonata* Reeve and *Engina melanozona* Tomlin.

Engina lineata (Reeve, 1846)

(Fig. 78)

1846. *Ricinula lineata* Reeve, Conch. Icon. 3: pl. 6, fig. 51.
1869. *Ricinula lineata*. var. *maculata* Pease, Amer. J. Conch. 5: 76, pl. 8, fig. 12 (Apaian I. = Abaiang I., Gilbert Islds.).
1962. *Engina lineata* (Reeve), Habe, Col. Illust. shells Japan 2: 61, pl. 31, fig. 1.

TYPE LOCALITY: Island of Ticao, Philippines.

The species is superficially similar to *Engina zonalis* Lamarck, but is slightly smaller, c.8.0-10.0 cm in length, the blackish spiral zones are narrow, continuous lines, and at the sutures are wide-spaced, round or crescent-shaped black spots. The aperture is white and not purplish-brown as in *E.zonalis*. In the Fiji Islands, *E. lineata* is collected more frequently than *E.zonalis*.

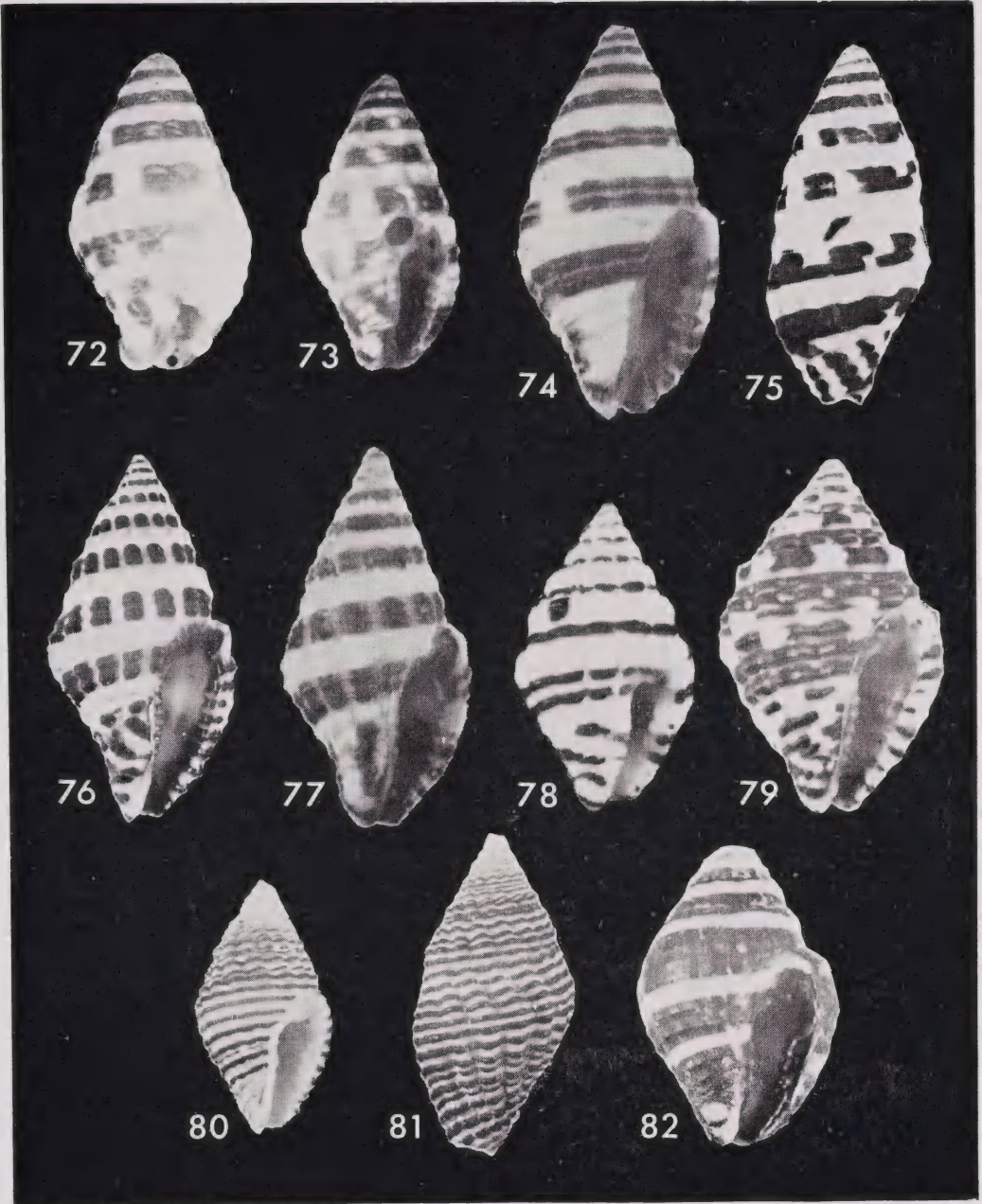
Engina phasinola (Duclos, 1840)

(Fig. 79)

1840. *Columbella phasinola* Duclos, Hist. nat. coq. univ., pl. 8, figs. 13-16.

TYPE LOCALITY: None.

Shell moderately small, 12-16 mm in length, solid; live-taken specimens black in colour, ornamented with irregular, scattered white spots. Sculptured with nodulose spiral cords, aperture very narrow, purplish-brown in colour, labial and columellar lips prominently denticulate.



Figs. 72-82. Shells. 72-75. *Engina zonalis* (Lamarck). 72. Syntype Mus. Hist. Nat. Geneva No. 1102/40; length 10.3mm. 73. Lectotype Mus. Hist. Nat. Geneva No. 1102/40; length 9.6mm. 74. Viti Levu Bay, Fiji I., intertidal; length 13.0mm. 75. Viti Levu Bay, Fiji I., intertidal; length 20.6mm (slender form). 76, 77. *E. alveolata* (Kiener). Viti Levu Bay, Fiji I., intertidal. 76. Length 21.8mm. 77. Length 12.8mm (variant without red spots). 78. *E. lineata* (Reeve). Manava I., Fiji I., intertidal; length 10.4mm. 79. *E. phasinola* (Duclos). Manava I., Fiji I., intertidal; length 12.3mm. 80-81. *E. incarnata* (Deshayes in Laborde & Linant). Manava I., Fiji I., intertidal. 80. Length 14.0mm. 81. Length 18.0mm. 82. *E. mendicaria* (Linnaeus). Viti Levu Bay, Fiji I., intertidal; length 16.6mm.

The species is uncommon throughout the Pacific region.

Engina mendicaria (Linnaeus, 1758)

(Fig. 82)

1758. *Voluta mendicaria* Linnaeus, Syst. Nat., ed. 10, p. 731.

1962. *Pusiosstoma mendicaria* (Linné), Kira, Col. Illust. shells Japan, rev. ed. 1:66, pl. 26, fig. 1.

TYPE LOCALITY: Asia.

In comparison with other Pacific *Engina* species, *E. mendicaria* is rather smooth, with only the early whorls axially costate; the species is purplish-black in colour, ornamented with yellow or white transverse zones of varying width. The columella differs from other *Engina* species in being smooth, apart from 1 to 2 anterior denticles. Specimens are commonly found under basalt rocks at the high tide level.

Engina incarnata (Deshayes in Laborde & Linant, 1834)

(Figs. 80-81)

1834. *Peristernia incarnata* Deshayes in Laborde & Linant, Voy. L'Arabie & Pétrée, figs. 20,21.

1844. *?Turbinella elegans* Dunker in Küster, Syst. Conch. Cab., ed. 2,3,(3A):33, pl. 7, fig. 4 (Hab: ?) [non *Engina elegans* Gray, 1839].

1846. *Ricinula astricta* Reeve, Conch. Icon. 3:pl. 4, sp. 30 (Hab: ?).

1879. *Peristernia paulucciae* Tapparone-Canefri, J. Conchyl. 27: 325 (Mauritius).

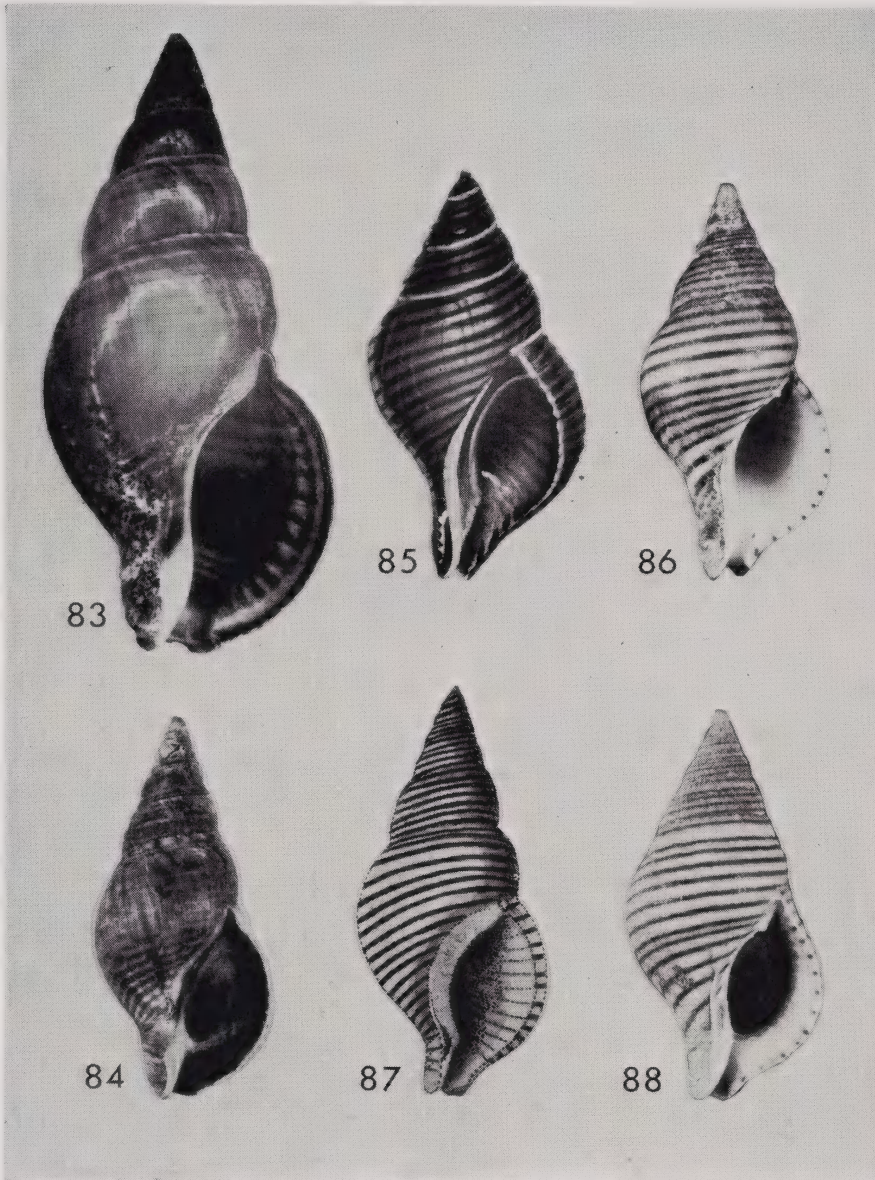
1880. *Peristernia kobeltiana* Tapparone-Canefri, Ann. Soc. Malac. Belg. 15(1): 71, pl. 2, figs. 14,15 (*spec. juv*) [non *P. kobeltiana* Tapparone-Canefri, 1879].

TYPE LOCALITY: Red Sea.

Shell moderately small, 13-20 cm in length, dirty-white or creamy-yellow in colour, spiral cords dark reddish-brown. Sculptured with close-set, rounded axial ribs and elevated reddish-brown spiral cords; interstices of spiral cords macroscopically axially striate and sometimes contain 1 or 2 very fine spiral threads. Aperture narrow, creamy-white with a slight pink hue, labial lip with 7-8 distinct denticles; columella calloused along entire length, denticulate, and lirate on parietal wall; siphonal canal short and straight.

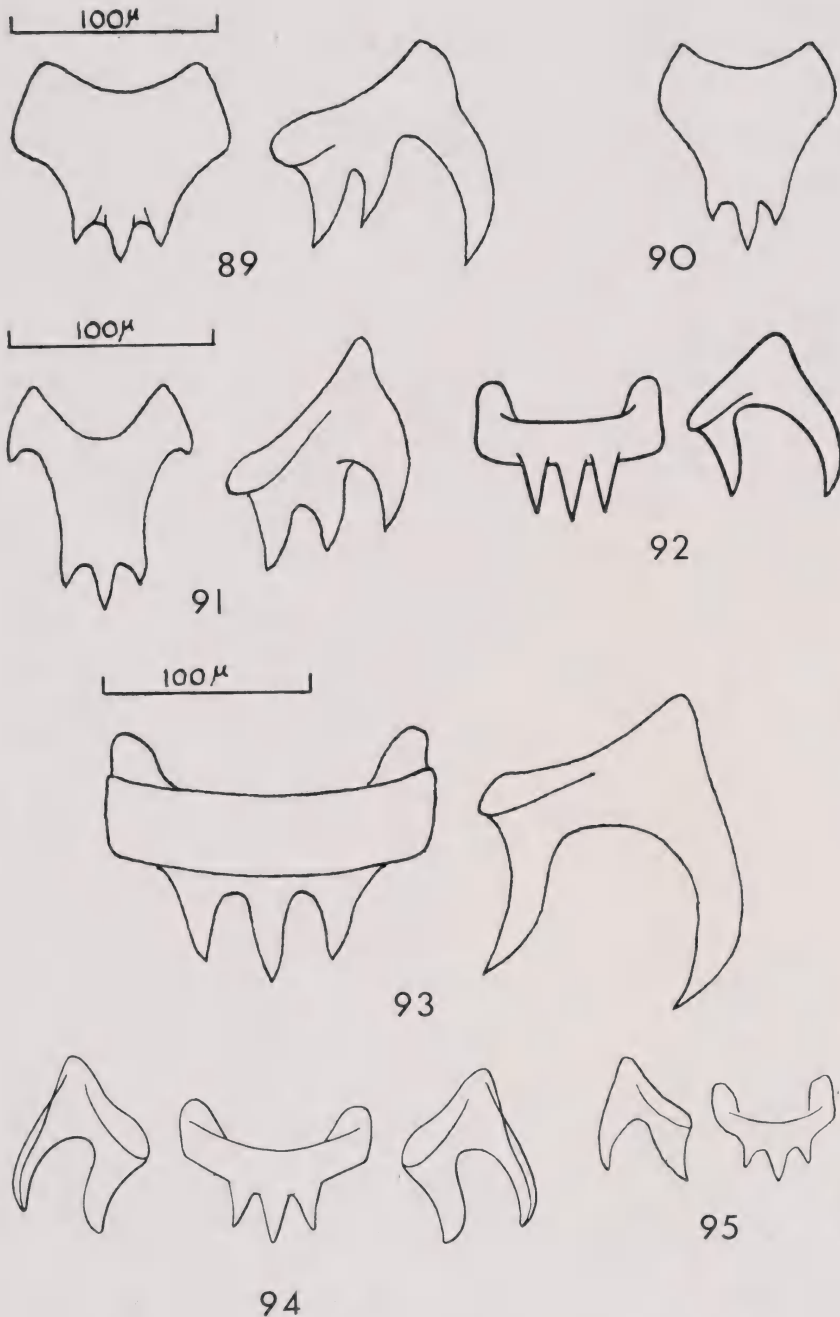
The species has been confused with a superficially similar *Peristernia* species. Kiener (1840 pl. 18, fig. 3) initiated the confusion by illustrating a different fasciolarid species under the name *Turbinella incarnata* Deshayes. Kiener's species has also been illustrated by Habe (1962, pl. 33, fig. 8) as *Peristernia incarnata*; this particular fasciolarid species has yellowish-brown, smooth axial ribs, the axial interstices are dark brown, the interstitial spiral threads are short and lammellate, the aperture is violet or rose-purple, the columella is smooth apart from a few anterior denticles and the siphonal canal is produced.

Deshayes' (1834) figures of *Engina incarnata* agree with Fiji specimens here illustrated in all essential details. The description of *Turbinella elegans* Dunker in Küster (1844, loc. cit.) is reminiscent of *Engina incarnata*, but the accompanying figure raises some doubt whether the two species are identical. In his description of *Peristernia paulucciae*, Tapparone-Canefri (1879) provided a fairly good diagnosis of the species, and his later illustration leaves no doubt that the figured species, although possibly somewhat faded, is the same species as *Engina incarnata*.



Figs 83-88. Shells. 83, 84. *Japeuthria ferrea* (Reeve). 83. Syntype of *Buccinum ferreum* Reeve. B.M.N.H.; length 32.6mm. 84. Minoshima, Wakayama, Japan; length 31.3mm. 85, 86. *Buccinulum linea* (Martyn). 85. Type figure of *Buccinum linea* Martyn (from Martyn. 1784, pl. 48, lower figure). 86. Milford, Auckland, New Zealand, intertidal; length 40.8mm. 87, 88. *Buccinulum lineatum* (Gmelin). 87. Type figure of *Murex lineatus* Gmelin (from Chemnitz, 1788, pl. 164, fig. 1572). 88. Worser Bay, Wellington Harbour, New Zealand; length 37.0mm.

Tapparone-Canefri (1879) proposed the substitute name *Peristernia kobeltiana* for *Turbinella zealandica* Kobelt, 1876, a species which is a *Latirus*. The figure of *Peristernia kobeltiana* Tapparone-Canefri, 1880, from Mauritius, (Tapparone-Canefri 1880, pl. 3, figs. 17,18) is an immature specimen of *Engina incarnata*.



Figs. 89-95. Radulae. 89, 90. *Buccinulum lineatum* (Gmelin). 89. Manukau Harbour, Auckland, New Zealand, intertidal. 90. Rachidian of radula of specimen from the same locality. 91. *B. linea* (Martyn). Pt. Chevalier, Auckland, New Zealand, intertidal. 92. *Cominella maculosa* (Martyn). Motuihe I., Hauraki Gulf, New Zealand (from Powell, 1929, fig. 127). 93. *C. virgata* (H. & A. Adams). Wellington Bay, New Zealand. 94. *Phos senticosus* (Linnaeus). Philippines (from Troschel, 1867, pl. 8, fig. 1). 95. *Northia northiae* (Griffith & Pidgeon). West coast of America (from Cooke, 1917, textfig.).

Engina incarnata has an Indo-Pacific distribution, and has been recorded as far East as the Tonga Islands (leg. H. C. Gay). In the Fiji Islands the species is rare.

Subfamily BUCCINULINAE Finlay, 1928

1928. Buccinulidae Finlay Trans. Proc. N.Z. Inst. 59:250.

The subfamily contains recent temperate water buccinids from the Mediterranean, South African and Austral-Neozelanic regions; some fossil species from Tertiary deposits of Indonesia may also be referable to this subfamily. Shells are moderate in size, the canal is slender and somewhat produced, the labial lip is either weakly denticulate, serrated or sculptured with elongated denticles; the columella is denticulate only anteriorly or along its entire length, and the parietal wall has a single denticle in adult specimens. The radula of species of *Buccinulum*, *Euthria* and *Afrocominella* is similar to the radula of *Pisania*; the rachidians and laterals are both tricuspid. The genus *Burnupena* from South Africa and *Japeuthria* from Japan, would probably be more correctly located in the Buccininae instead of the Buccinulinae. The radula of *Japeuthria ferrea* (Reeve), (Fig. 61 radula, Figs. 83, 84 shell), the type species of *Japeuthria* Iredale, has rachidians which are similar to those of *Burnupena* and *Buccinum*.

Genus *Buccinulum* Deshayes, 1830

Buccinulum Deshayes, 1830, Encycl. Méth. vers, ed. 2, 2 (1): 143. Type species by SD (Iredale, 1921 — art. 69(a) (ii) ex-Swainson, 1837) *Murex lineatus* Gmelin, 1791. Recent, New Zealand.

1853. Evarne H. & A. Adams, Gen. Rec. Moll. 1:79. Type species by M *Fusus* (Evarne) *linea* Mart. = *Buccinum linea* Martyn, 1784. (Nom. conserv.).

Buccinulum lineatum (Gmelin, 1791)

(Figs. 87-90)

1788. "*Murex lineatus* Chemnitz", Syst. Conch. Cab. 10:278, pl. 164, fig. 1572 (New Zealand) [non binom.].

1791. *Murex lineatus* Gmelin, Syst. Nat., ed. 13, p. 3559 (ref. Chemnitz, op. cit. fig. 1572).

1929. *Buccinulum* (Evarnula) *multilineum* Powell, Trans. Proc. N.Z. Inst. 60:78, pl. 1, figs. 17, 18 & textfig. 90).

TYPE LOCALITY: New Zealand.

The type species of *Buccinulum*, i.e. *B. lineatum* (Gmelin), is not the same species as *B. linea* (Martyn) (Fig. 86), but is conspecific with the species currently known in malacological literature as *B. multilineum* Powell.

Apart from prominent differences in the radulae (Figs. 89-91) and egg-capsules, morphological differences in the shells of *B. linea* and *B. lineatum* are subtle indeed. The only single, constant differentiating character of the two species is the outline of the sinistral side of the body whorl when viewed ventrally. In *B. linea* the central point of the concave constriction passes through the lower third of the columella, whereas in *B. lineatum* the centre of the constriction is lower, i.e. near the commencement of the siphonal canal. The siphonal canal in *B. linea* appears longer and straighter, but shorter and somewhat recurved in *B. lineatum*.

Martyn's (1784) figure of *Buccinum linea* (Fig. 85) shows the *Buccinulum linea* of authors; the canal is elongated and straight and the centre of the constriction is positioned well above the start of the siphonal canal. The figure of *B.lineatum* from Chemnitz (1788) is an unmistakable illustration of the species *B.multilineum* Powell (Figs. 87-88).

Subfamily PHOTINAE Troschel, 1867

1867. Photina Troschel, Geb. Schnecken 2(2) : 82.
 1881. Photinae Tryon, Man. Conch. 3:98.
 1901. Cominellinae Cossman, Ess. paléoc. comp. 4:137.
 1913. Cominellinae Suter, Man. N.Z. Moll., p. 391.

The subfamily contains species with a very short or only slightly produced and notched siphonal canal, a labial lip without denticles and a striate or lirated labrum; species of some Miocene genera have distinct growth-varices. The radula of Photinae (Fig. 94-95) consists of tricuspid rachidians with loop-like basal extensions and laterals which are bicuspid.

Powell (1929) assigned the genera *Cominella*, *Fax*, *Phos*, *Pareuthria* and *Searlesia* to the Cominellidae. *Northia* Gray and several Caribbean Miocene *Phos*-like and *Cominella*-like genera (e.g. *Calophos ectyphus* Woodring, 1964), are also referable to this subfamily. The subfamilial name Photinae has chronological priority over Cominellinae, and no evidence has been advanced to date which would necessitate a familial separation of the Photinae from the Buccinidae.

Genus *Phos* Montfort, 1810

- Phos* Montfort, 1810, Conchyl.Syst. 2:495. Type species by OD *Phos senticosus* = *Murex senticosus* Linnaeus, 1758. Recent, Indo-Pacific.
 1840. *Rhinodomus* Swainson, Treat. Malac., p. 305. Type species by M. *R.senticosus* Chemnitz = *Murex senticosus* Linnaeus, 1758.

The subfamily is represented in the Fiji Islands by the widely distributed, tropical species *Phos senticosus* (Linnaeus).

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